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SHIVA'S DANCE:

CRISIS, LOCAL INSTITUTIONS AND PRIVATE FIRMS

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Shiva's Dance: Crisis, Local Institutions and Private Firms[1]

ABSTRACT

The uneven spatial distribution of start-ups and their respective survival may reflect comparative advantages resulting from the local institutional background. For the first time, we explore this idea using Data Envelopment Analysis (DEA) to assess the relative efficiency of Portuguese municipalities in this specific context. We depart from the related literature where expenditure is perceived as a desirable input by choosing a measure of fiscal responsibility and infrastructural variables in the first stage.

Comparing results for 2006 and 2010, we find that mean performance decreased substantially 1) with the effects of the Global Financial Crisis, 2) as municipal population increases and 3) as financial independence decreases.

A second stage is then performed employing a double-bootstrap procedure to evaluate how the regional context outside the control of local authorities (e.g. demographic characteristics and political preferences) impacts on efficiency.

KEYWORDS: Entrepreneurship, Political Economy, Public Finance, Efficiency, Portuguese municipalities, Accountability

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João dedicates this thesis to his grandfather, the man who taught him what to read.

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I. Introduction

The Global Financial Crisis deteriorated citizen's confidence in policymakers and weakened individual future prospects. On the one hand, reforms intended at enhancing the efficiency of all levels of government have been increasingly gaining importance. In this context, local public services are especially under scrutiny as more decentralized policies are being designed and monitoring costs for voters are lower (Devas and Delay, 2006). On the other, high unemployment rates have called for the resurgence of entrepreneurship as a viable career option. The continual process of creation and destruction (*Shiva's Dance* in the Hindu culture) is, once again, perceived as vital to society's dynamics. This paradigm shift, however, is not blind to recognize that benefits of newcomers come at a cost of some incumbents.

This paper attempts to provide a systematic investigation on the role of municipalities in creating the conditions to encourage private firm establishment and development. We use a linear frontier technique – Data Envelopment Analysis (henceforth, DEA) – to assess, in the first stage, relative performance in this context.

Providing incentives for greater transparency and enhanced competition among municipalities is especially important as this exercise can be subject to some misgivings and misinterpretations. Indeed, oftentimes, not all the appropriate variables are taken into consideration, which might end in biased results. The current report addresses these concerns by computing preliminary regression-based results, and in the second stage, the double-bootstrap proposed by Simar and Wilson (2007) to evaluate the determinants of relative performance. All in all, we explore a comprehensive set of variables based on – but not uncritically accepting – the related literature, as well as on the specific features of Portuguese municipalities. As we want to unveil how the regional context changed

with the crisis, we selected data from two post local (and national) election years (2006 and 2010) to comment on the evolution before and during the turmoil. This option is encouraged by evidence gathered by Veiga and Veiga (2006) and Aidt et al. (2011) on the presence of rational political business cycles (PBC) at the municipal level. In line with the Rogoff (1990) model, bureaucrats ended up distorting expenditures and taxes to signal greater competency in the two years before elections.[2]

Portugal is a particularly interesting case study for this purpose. Firstly, the titanic effects of the economic crisis provide a good testing ground for possible changes in relevance between factors. Secondly, our dataset is based on a single country rather than a combination of several states with diverse policy instruments. Thirdly, representatives are chosen in highly partisan elections. Lastly, mainland municipalities are all subject to the same rules (including coincident election dates).

One should note that this investigation does not focus on capturing factors which may impact on birth and death rates on a national level but are unlikely to diverge across municipalities such as the minimum efficient scale in different sectors or macroeconomic fluctuations. We are primarily concerned with what may govern regional dissimilarities, comparing their evolution before and during the financial crisis.

This study is organized as follows: in section II, a short tour on the related literature is provided while, in III, some stylized facts about Portuguese local governments are presented. In section IV, the empirical strategy is addressed. Regarding the first stage, V clarifies which inputs and outputs are selected, and section VI discusses the results. For the second stage, VII reports the non-discretionary factors considered, whereas VIII explains the results. Finally, section IX concludes.

[2] The theory of PBC was popularized by Nordhaus (1975). Empirical investigations of rational PBC include Alesina and Roubini (1992), Alesina et al. (1993) and, for Portugal, Baleiras and Costa (2004).

II. Literature Review

Our intent in this section is twofold as we will survey both the literature on the regional determinants of firm creation and destruction, and the methodological advances in assessing municipal efficiency.

Entrepreneurship, to begin with, is a topic of growing interest for academics and policymakers. Even if one does not believe either in a Marxian contradiction ("capitalism cannot survive because of economic failure") or in a Schumpeterian paradox ("capitalism is being destroyed because of its very creative success"), the role of *creative destruction* is key (Elliott, 1980). The idea itself is a very old one. But it was only since Schumpeter (1934) that researchers have been pointing out a whole array of benefits produced by entrepreneurs ranging from employment (Blanchflower, 2000 and, for Portugal, Baptista et al., 2014) to production (Audretsch and Feldman, 1996) and innovation (Acs and Audretsch, 1988).[3]

Concentration is not a new concept for economists since Marshall (1920) concluded that external economies of scale arise on a regional level. In recent times, more attention has been devoted to inspect the relevance of entrepreneurship for local growth and the causes of its regional variation.[4] In this regard, Armington and Acs (2002) describe regional externalities (or agglomeration effects), unemployment, entrepreneurial culture and industrial restructuring as the main topics to be considered. All of them are reflected throughout the remainder of this paper.

In Portugal, Figueiredo et al. (2002) concluded that investors tend to locate in close proximity of their residence area. Nevertheless, firm births seem erratically distributed

[3] These contributions (together with a long tradition of several papers) confirm predictions stated by the endogenous growth theory (Romer, 1990) and new economic geography (Krugman, 1991).

[4] For good references on the importance of defining the concept of "regional competitiveness" as well as the theoretical, empirical and policy debate involved see Porter (2003) and Kitson et al. (2004). For a good recent survey see Fritsch (2008).

through the territory when controlling exclusively for population. This suggests that other dynamics associated to the local environment constrain entrepreneurial intensity.[5]

The literature on municipal efficiency can be divided into individual or global public services. While the former focuses on specific public goods that are provided by each municipality, the latter consists in a performance assessment of local authorities as a whole. For the second case, noteworthy contributions by Afonso and Fernandes (2008) and Cruz and Marques (2014) on Portuguese municipalities for the years of 2003 and 2009, respectively, should be highlighted. Both concluded that the large majority of municipalities could improve overall performance without necessarily increasing their spending items. In a nutshell, Table 1 summarizes the main findings.[6]

III. Portuguese Institutional Framework: Local Government Sector

Sub-national governments in Portugal assume only two levels: the autonomous regions of Madeira and Azores, and administrative municipalities. The first municipal elections under democratic rule took place in 1976 and, since then, there has been an important widespread of local governments' competencies. For instance, they are responsible for the promotion of education, health, transport, communication, culture and leisure. After joining the European Economic Community in 1986, municipalities' funds increased considerably and, in 1999, there were new extensions of their activities to enhance, among other responsibilities, the attraction of private investment (Law 159/99).

[5] For more details on Portuguese firms see Mata et al. (1995) and Cabral and Mata (2003).

[6] A special focus is devoted to a plethora of papers exploring non-parametric techniques. Examples of studies covering individual public services include energy and water provision (von Hirschhausen et al., 2006 and Byrnes et al., 2010, respectively), public transportation (Walter and Cullmann, 2008), road maintenance (Kalb, 2009), public libraries (Witte and Geys, 2009), fire protection (Lan et al., 2009), local police forces (García-Sánchez, 2009), child-care provision (Montén and Thater, 2011) and recycling systems (Marques et al., 2012). For global public services, relevant empirical work was made for Belgium (De Borger et al., 1994 and De Borger and Kerstens, 1996), Spain (Prieto and Zofio, 2001 and Balaguer-Coll et al., 2007), Finland (Loikkanen and Susiluoto, 2005), Brazil (Sousa and Stósic, 2005) and Germany (Bönisch et al., 2011).

Portuguese municipalities are governed by the Municipal Assembly and the Town Council. The top candidate from the most voted list becomes the president of the Town Council (mayor) and, at the end of each year, this executive body designs the local budget and the plan of activities for the next period. The process of implementing local policies requires the approval of the legislative body (Municipal Assembly) and is subject to both internal and external control mechanisms from central government agencies and the Court of Accounts.

In this context, municipalities are responsible for the bulk of consolidated expenditures of the local tier of government and such item is divided into current and capital expenditures. The subcomponents of the first part include expenditures on goods and services, and compensation of employees while those associated to the second share comprise investment, financial assets and liabilities, and capital transfers to parishes.

As for revenues, despite the fact that local authorities are financially independent, their main sources of income still rely on transfers from national and European funds. Moreover, this redistributive nature is especially imperative for poor municipalities. On the other hand, the relative importance of real estate as a fiscal basis for local taxes has significantly increased in the past few years since municipalities have, within certain limits, the autonomy to set property tax rates (*IMI*). Remaining resources come from vehicle, property transfer and corporate income taxes, fees, fines and debt.[7]

IV. Empirical Strategy

DEA is a non-parametric methodology (i.e., a maximum likelihood *estimate* of an unobserved *true* frontier, conditional on data which is not required to fit a normal

[7] For a rigorous exploration on the country background see Tavares (2004) and Blanchard (2006). For further details on Portuguese municipalities see Silva (2008), Costa et al. (2013) and Martins and Veiga (2013). Table A.1. provides a comparison among local governments in Europe.

distribution) that does not try to answer how a certain quantity of output resulted from the political process. Nor does it represent welfare equilibrium from a benevolent social planner perspective. Instead, as an output-oriented strategy is followed, it just analyzes whether the maximum output is attained *vis-a-vis* the given quantity of inputs provided in the municipality.[8] The reason behind this choice is motivated by the fact that political agents may have an incentive not to use inputs optimally (Niskanen, 1975 and Hayes et al., 1998). Furthermore, as previously stated, Portuguese local government's areas of intervention are very broad, and their tasks are not restricted towards creating an appropriate environment for business formation.

To the best of our knowledge, this is the first time that DEA is used to study this phenomenon. We believe this is a suitable approach for several reasons. According to De Borger and Kerstens (1996, p. 167), "to the extent that there are no *a priori* reasons to prefer one methodology over the others and as long as there is no solution to the problem of choosing the "best" reference technology (…), it seems to be preferable to analyze public sector efficiency questions using a broad spectrum of different methods and to find out just how robust the results are". If we pursued, for example, an econometric cost or expenditure function approach, we would be assuming that the underlying production function was efficient. In this setting, the error term would therefore contain inseparable inefficiency and statistic misspecification components (Bönisch et al., 2011). Moreover, although parametric approaches such as the stochastic frontier analysis present the advantage of allowing deviations from the efficient frontier due to stochastic influences or measurement errors, they are usually not realistic when price data is not available. In fact, although the notion that the cost-inefficiency and

[8] An input-oriented strategy evaluates how much input quantities can be proportionally reduced while keeping constant the quantity of outputs.

statistical noise are uncorrelated may be reasonable with cost equation variables for competitive markets, it may be less convincing if there are producer-specific differences in the quality of the output created (Greene et al., 2013).[9] Prices in DEA are unknown but, given that all municipalities in Portugal have access to the same capital market and are constrained by the same collective wage agreement, they are assumed to be identical. In addition, DEA does not require an *a priori* assumption of a particular functional form for public decision making units (henceforth, DMU). Finally, another important characteristic of DEA, in sharp contrast to other parametric methods that determine an idealized standard of performance, is that this technique seeks to examine the efficiency of a DMU (e.g., municipality) *relative* to its peers.

DEA was introduced in the economic literature by Charnes et al. (1978) based on the seminal contribution by Farrell (1957). One should note that efficiency is understood in this scheme as the ratio between a weighted sum of outputs and a weighted sum of inputs.[10] A convex hull is thus computed from data on a multiplicity of inputs and outputs by applying linear programming techniques not subject to statistical problems such as simultaneous equation bias (Afonso and Fernandes, 2008). To form a piecewise production possibilities frontier, the number of inputs and outputs should be low as they would otherwise be compared along more dimensions and, subsequently, the number of efficient DMUs would be larger. Scores are derived on the basis of relative distances of inefficient observations from the frontier. To do so, we solve the following problem for municipality *j*, having each one the outputs y_o and the inputs x_o:

[9] For a good survey on the comparison between the different parametric and non-parametric methods see De Borgen and Kerstens (1996), Worthington and Dollery (2000) and Coelli et al. (2005).

[10] More information on DEA can be found in Cooper (2000) and Thanassoulis et al. (2008). In the economic literature, three main measures of efficiency are mentioned: technical, allocative and dynamic efficiency. Since we refer to the use of inputs in the most technologically efficient manner, technical efficiency considerations are therefore developed in this paper.

$$\text{Max } \theta_0$$

$$\text{Subject to } \sum_{j=1}^{n} \lambda_j x_j \leq x_0 \quad (1)$$

$$\sum_{j=1}^{n} \lambda_j y_j \geq \theta_0 y_0 \quad (2)$$

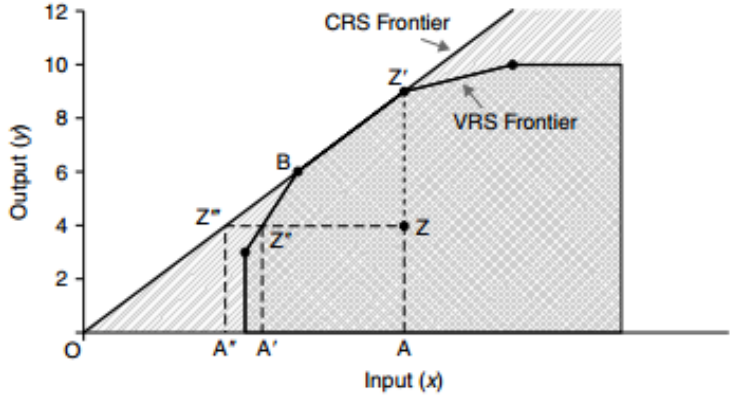
$$\sum_{j=1}^{n} \lambda_j = 1 \quad (3)$$

$$\lambda_j \geq 0 \quad (4)$$

Where θ_0 is a scalar showing by how much the production of each DMU could increase and λo are weighting factors defined optimally in the model for each municipality. Therefore, DEA gives the "benefit of the doubt" to each unit being evaluated by trying to make it look as efficient as possible in comparison with the others.

At this stage, two important remarks must be added. First, an efficient DMU (θ_0 =1) implies relative (not strictly or Pareto) efficiency. This means that these units represent the best existing – but not necessarily the best possible – operating units. Second, by adding the constraint (3) to the previous problem, we take into account the possibility that some DMUs might not be operating at the optimal scale. Hence, we are assuming variable returns to scale (VRS) outlined by Banker et al. (1984) rather than constant returns to scale (CRS).[11] A comparison between the two can be found in Figure 1.

Figure 1. CRS vs. VRS specification (Source: Thanassoulis et al., 2007)



[11] Additionally, Hollingsworth and Smith (2003) defended that VRS are the correct design when one uses ratios instead of absolute numbers as inputs and outputs.

The criterion adopted to assess efficiency is straightforward. In the first stage, we decided to use inputs that are, at least to a certain degree, manageable by the municipality and the exogenous outputs of interest to our research question. A second stage is then required in order to explain how environmental factors that are not part of the production process (e.g. political preferences) constrain the choices of both inputs and outputs, and thus, impact on performance. In this part, several papers calculated a censored (tobit) regression given that the dependent variable – the efficiency scores calculated in the first stage – cannot take values lower than one. However, this raises a problem of paramount importance as the process that regulates the probability of censuring is the same process defining how the uncensored observations are restricted (Ruggiero, 2004). Another concern is advanced by Simar and Wilson (2007). As inputs and outputs are correlated with the non-discretionary factors (otherwise it would not make sense to use them), the error term of the second stage is serially correlated with the efficiency scores. These scholars, using Monte Carlo experiments, developed a solution that will be implemented in section VIII of this paper: first, by employing a truncated regression and, afterwards, by establishing inference on a bootstrap procedure in which the performance score is bias-corrected and serial correlation is considered.[12]

V. First Stage: Dataset, Inputs and Outputs

In order to elect the most appropriate inputs, several preliminary regression-based robustness checks were conducted. The purpose is to empirically investigate the reliability of our options and diminish the level of *ad-hoc* choice of inputs to be comprised in the frontier estimation.[13] Even taking this strategy into consideration, our

[12] An important alternative is to perform the second stage via non-parametric smoothing techniques as proposed by Balaguer-Coll et al. (2007).

[13] A detailed explanation of the inputs and output variables and data sources is offered in Table A.2. Results of these previous robustness checks are shown in Table A.3. Additionally, Arouca (2013, p. 2) put

choices are not free from criticisms. Hence, we should hereafter explain each of the four institutional inputs under three different crucial vectors[14]:

– **Infrastructural geographic planning**. Through the synergies of exploring an integrated location with informational spillovers, we expect that *Industrial areas* increase the likelihood of firm formation. Audretsch et al. (2004) illustrate the expansion of industrial parks, science and technology incubators as the most effective start-up oriented policy. Furthermore, tourism is a strategic segment for the Portuguese economy and, for this reason, *Tourism areas* are also considered;

– **Governance responsibility**. Variables related to spending (e.g., total or capital expenditures) are widely used in the literature (see Table 1). Nonetheless, we fail to find empirical support for this option as more inputs (namely, financial resources) are not necessarily translated into more outputs in the presence of unbalanced budgets.[15] We compute instead a measure of fiscal responsibility to ascertain the extent of interest payments in each municipality – *Primary expenditures/Total expenditures*. This constitutes a *proxy* for quality of spending rather than for quantity in the sense that money used to pay interests is not directed to improve local governments' competencies. Moreover, a rational forward-looking entrepreneur will not take into account only the tax rates prevailing in a given year since she or he knows that more debt in the present will be reflected in a higher tax burden in the future;

– **Licensing outline**. Public administration construction items are typically highly visible and help form expectations at the level of prevailing bureaucracy in the municipality. Wagner and Sternberg (2004) stressed that the extensiveness of

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emphasis on the importance of "both the development of business-related infrastructures and the signals stemming from sound financial management".

[14] For comparability reasons, we confine our attention on the 278 mainland municipalities because those overseas are subject to vertical externalities from an extra layer of power and specific fiscal benefits.

[15] For example, raw results of a quadratic fitting between *Entry_inc* and the most referred expenditure variables (see Figure A.2) re-confirm the appropriateness of our choices. This idea is in accordance with evidence collected by Borge et al. (2008) and Arouca (2013)

cumbersome regulatory requirements can discourage the creation of new ventures. We *proxy* these effects using a *construction ratio*, measured as the ratio between the predicted duration of construction works and their effective duration.

At the same time, we adopt two outputs with data drawn from *Quadros de Pessoal*, a yearly mandatory questionnaire on all companies with paid labor, to understand local entrepreneurial culture in Portugal:[16]

– Start-up attraction. We decided to use the number of new business units divided by the incumbent firms (in this case, *Entry_inc*) to properly reveal the effects of regional clusters and measure the entry of new capabilities, an essential element of the market process.[17] This approach relies on the idea that "for a meaningful comparison of regions or industries of different size or different economic potential, the number of start-ups has to be related to a measure of this economic potential" (Fritsch, 2008 p.5);

– Firm survival. A similar strategy is followed as far as exits are concerned, but we transform this bad into a desirable output by taking its inverse (*Exit_inc_inv*) as recommended by Thanassoulis et al. (2007).

Descriptive statistics of all inputs and outputs used to compute the efficiency of Portuguese mainland municipalities are presented in Table 2 for 2006 and 2010.[18] To properly reflect the effects of the crisis, two further analyses are added: whereas Figure 2 highlights the uneven geographical pattern of private firms' net entry (*Entry_inc* – *Exit_inc*), Figure 3 displays the sharp differences between *Entry_inc* (higher in 2006) and *Exit_inc* (lower in 2006) distributions for both periods.

[16] Accordingly, cases of self-employment or family workers are not contemplated in *Quadros de Pessoal*. At the same time, other organizations such as public entities, foundations, associations or cooperatives are exempted from our analysis due to their non-profit nature. Furthermore, given its longitudinal matched employer-employee character, this source connects workers to their corresponding establishments and companies/ headquarters, with only the latter being considered in our analysis.

[17] In a given year, a plant is identified as *Entry* (*Exit*) if it was absent in the files for the two preceding (following) years (Mata and Portugal, 1994). For other examples of past usage see Mata et al. (1995), Cabral and Mata (2003), Holl (2004), Baptista and Mendonça (2010) and Mata and Freitas (2012).

[18] We cope with zeros in data by replacing them by 0.0001 as suggested by Bessent and Bessent (1979).

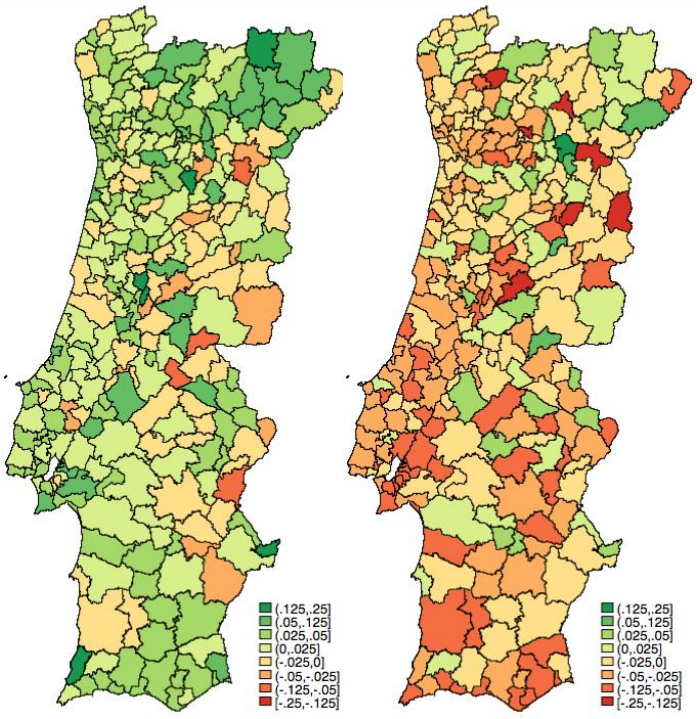
Table 2. Summary statistics for Inputs (I) and Outputs (O) in 2006, 2010 (Source: own construction)

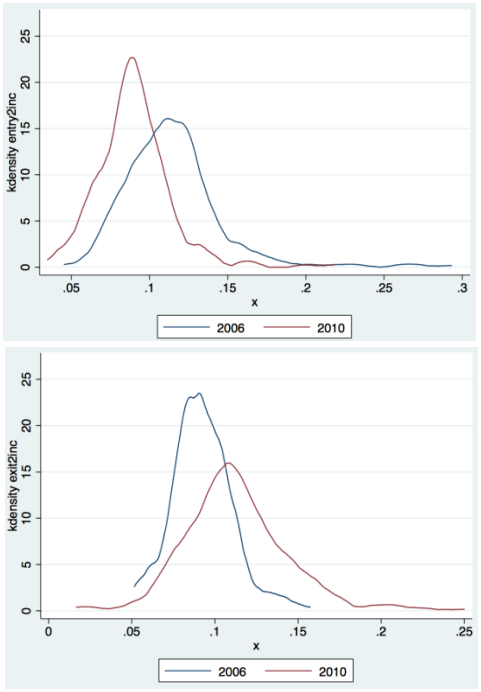
Variables	Mean	Std. dev.	Min	Max	Obs
(I) *Industrial area*					
2006	0,0142	0,0229	0,0001	0,1505	278
2010	0,0141	0,0225	0,0001	0,1505	278
(I) *Tourism area*					
2006	0,0034	0,0118	0,0001	0,1054	278
2010	0,0035	0,0117	0,0001	0,1054	278
(I) *Primary expenditures/ Total Expenditures*					
2006	0.9814	0,0153	0,8875	1	278
2010	0,9866	0,0139	0,8585	1	278
(I) *Construction ratio*					
2006	0,7584	0,1162	0,4590	1,0937	278
2010	0,7560	0,1111	0,4590	1,0937	278
(O) *Entry_inc*					
2006	0,0114	0,0316	0,0455	0,2931	278
2010	0,0781	0,0235	0,0347	0,2181	278
(O) *Exit_inc_inv*					
2006	11,2631	2,3315	2,3315	6,3571	278
2010	9,6705	3,5975	4	39	278

Figure 2. Municipal *Net Entry_inc* in 2006 and 2010, respectively.

Figure 3. *Entry_inc* and *Exit_inc* densities, respectively, for 2006 and 2010

(Source: own construction with data from *Quadros de Pessoal*)

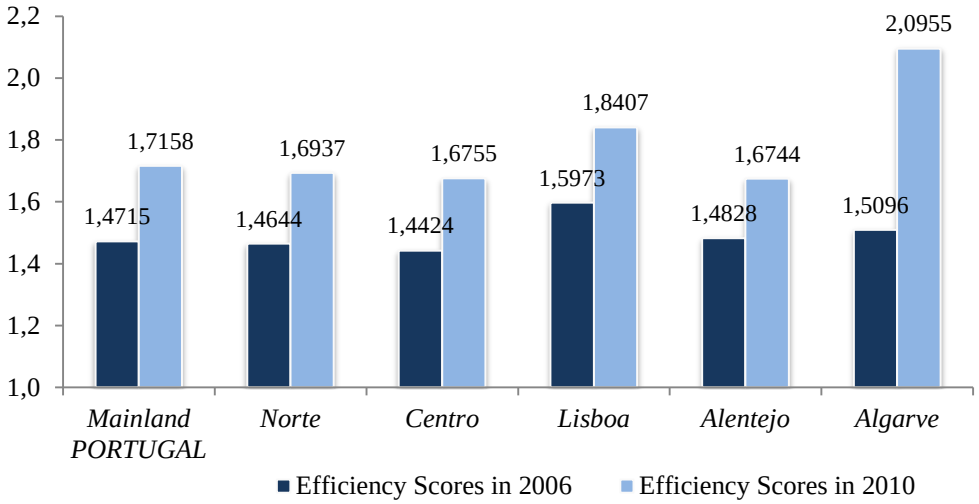




VI. Assessing efficiency results and brief discussion

The results of the VRS output-oriented DEA calculations for mainland local authorities, along with average results per NUTS 2 regions, can be found in Figure 4. To properly interpret them, one should recall that the higher the value of θ_j, the less efficient is the DMU given the referred inputs and outputs.

Figure 4. Average relative inefficiency scores per NUTS 2 (Source: own construction)



Notes: Number of efficient units in 2006 (14/278*: Ovar, Barrancos, Alfândega da Fé, Vinhais, Oleiros, Proença-a-Nova, Sertã, Nelas, Redondo, Reguengos de Monsaraz, Almeida, Monforte, Chamusca and Ribeira de Pena*) and in 2010 (10/278: *Barrancos, Castro Verde, Vinhais, Idanha-a-Nova, Oleiros, Vila Velha de Rodão, Reguengos de Monsaraz, Monforte, Vila Nova da Barquinha and Ribeira de Pena*).

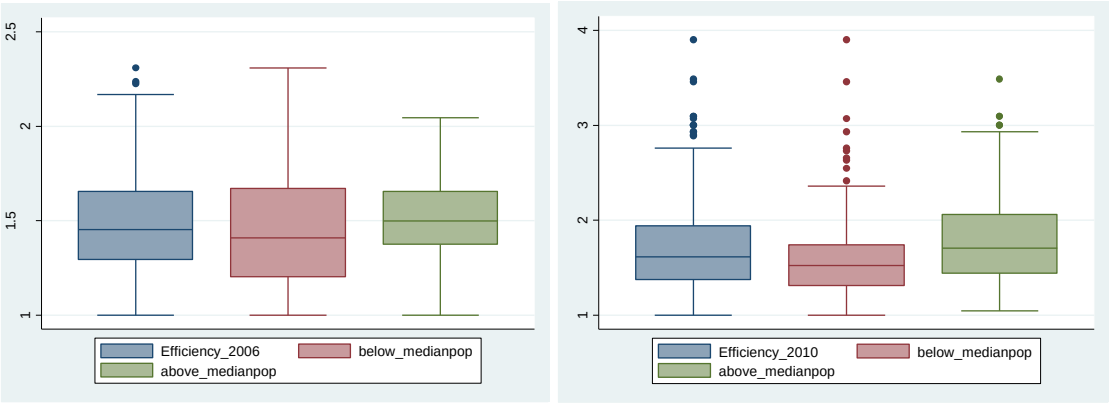
In this framework, one can clearly observe the rampant effects coincident with the eruption of the Global Financial Crisis on municipal performance in Portugal. From one period to the other, scores deteriorated sharply as the mean relative inefficiency increased from 1,4715 in 2006 to 1,7158 in 2010. These results can be read in the following way: net private firm entry divided by incumbents could be, on average and given the local inputs, more than 47% higher in 2006 and almost 72% higher four years later. Moreover, these results are persistent if we cluster for all NUTS 2 regions.

We also portray yearly efficiency scores (in blue) by means of Tukey's boxplots in Figures 5 and 6.[19] In addition, we separate, for both years, results below (in red) and above (in green) the median.

First of all, we exhibit performance scores for small and large municipalities (in terms of population) in Figure 5.

[19] Boxplots are particularly instructive as DEA is bounded by one, and a mass of DMUs reaches this lower bound leading to skewed distributions. They offer a simple and scrupulous image which encodes information on the existence of outliers. For each class, the box defines the 50% mid-range values of the efficiency scores, while the breakdown line and the length within each box respectively represent the median and the interquartile range (IQR). Furthermore, whiskers characterize the natural bounds of the distributions whereas points denote outliers.

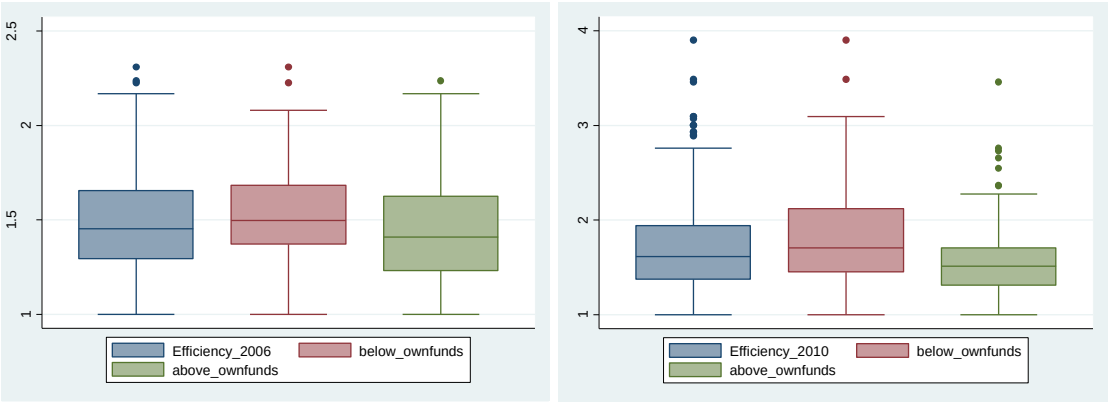
Figure 5. Tukey's boxplots (for 2006 and 2010, respectively) comparing relative inefficiency scores below and above local median population (Source: own construction)



As a result, one can discern that, on average, smaller municipalities are more efficient in creating the conditions to attract and/or to retain private firms than their larger counterparts. These findings thus corroborate those of Loikkanen and Susiluoto (2006), where the largest cities are absent from the top list.

In DEA literature, financial dependence is usually negatively associated with municipal performance (see Table 1). We thereby divided the efficiency results below and above the median of a measure of fiscal autonomy in Figure 6. For this exercise we considered the percentage of own funds generated by the municipality in relation to its total revenues (which decreased from 48,65% in 2006 to 44,85% in 2010, on average).

Figure 6. Tukey's boxplots (for 2006 and 2010, respectively) comparing relative inefficiency scores below and above a measure of financial independence (Source: own construction)



We found that more financially independent regions appear to display better performance records, especially in 2010. Subsequently, the outcomes in Figures 5 and

6, which constitute evidence that smaller and less dependent municipalities are more resilient to crises, are in accordance with the efficiency-enhancing effect of voter involvement advocated by Geys et al. (2010).

Nevertheless, these findings should be subject to a more refined scrutiny (namely, a second stage) as these raw analyses may hide important features. For example, more dependent municipalities are also those *a priori* poorer and, for this reason, they receive higher contributions from the national budget and more European cohesion funds.

VII. Second Stage: Environmental Dataset and Theoretical Hypothesis

The inefficiency found in the previous section may not be exclusively attributable to poor municipal management. As Afonso and Fernandes (2008, p. 1985) put it, "one has to assume that some municipalities are unable to achieve the "best-practice" due to a relative harsh environment". The following non-discretionary factors – i.e., outside the mayor's control, at least in the short-run – are thus taken into account to evaluate which of them drive the ability of local authorities to generate higher performance levels:[20]

– Demography. Given that local governments are closer to citizens, decentralization presents several informational benefits for voter's accountability. For instance, one could refer the Tieboutean hypothesis (1956) regarding the analogy between competing regional governments and private firms or Oates' theory (1972) stating that better matching arises when local preferences are heterogeneous. Despite all these advantages, decentralization may also contribute to higher administrative costs and to negative externalities originated by a lack of coordination and risk sharing. Therefore, it is unclear whether high *Population Density* is detrimental (Geys, 2006) or helpful (Geys et al., 2010) to efficiency. Moreover, to account for the population age-structure, a high

[20] A detailed explanation of all environmental variables and data sources is offered in Table A.4. Correlation matrices are presented in Table A.5 (for 2006) and Table A.6 (for 2010).

Dependency ratio is expected to have a negative influence on the capacity to attract investment and hence on municipal competitiveness;

– Political preferences. Firstly, to test Cox and McCubbin's (1986) hypothesis that the central government may favor his supporters in the allocation of funds, we introduce a dummy variable that takes the value of one when the prime-minister and the mayor belong to the same political party (*SamePolParty*) as suggested by Veiga (2011). Secondly, to control for the effects of distinct political ideologies and agendas, we use the fraction of *Leftist Mandates* in each jurisdiction. In this regard, since Reynolds et al. (1994) argued that right-wing conservatism tends to be related with a resilient entrepreneurial culture, a negative coefficient is expected. Thirdly, it is not clear whether the effects of strong majorities regarding efficiency are positive (Borge et al., 2008) or negative (Kalb et al., 2012). Consequently, a *Majority dummy* is added. Lastly, as the electoral engagement fosters civic awareness (Geys et al., 2010), *Abstention in local elections* is also considered and a positive coefficient is anticipated;

– Human Capital. We include micro level data regarding the percentage of *graduates* in each municipality for two reasons. Hamilton (1983), on the one hand, defended that the ability to monitor local efficiency depends on the educational level of residents. On the other, Baptista and Mendonça (2010) found that regional access to knowledge and an educated workforce significantly influences firm location in specific sectors;

– Wealth. Evans and Jovanovic (1989) and later studies showed that wealthier people are more inclined to become entrepreneurs because liquidity constraints tend to exclude those with insufficient funds at their disposal. To properly control these effects, we *proxy* municipal wealth using the *mean value of real estate*;

– Justice. In recent times, an important debate regarding the reforms in the judicial system arose in Portugal. To understand if the access to justice is relevant for business

creation and development, we add the *Number of first instance courts* and, if significant, a positive impact is expected;

– **Accessibility**. We account for the possibility that new motorways increase the attractiveness of locations close to, at least, one of these infrastructures (Holl, 2004) using a *Highway dummy;*

– **Labor market**. To take into consideration the effects of a depressed labor market environment, we enlarge our analysis with the *unemployment rate*. Fritsch and Falck (2007) put forward that a high level of short-term unemployment has a positive impact on the number of start-ups. The effects in the long-run, however, may be different depending on the displacement *vis-à-vis* the induced effects of entrepreneurship on regional employment (Mueller et al., 2008).

To conclude, the summary statistics of all environmental factors, along with the theoretical hypothesis above defined, are shown in Table 3.

VIII. Evaluating Efficiency Results and Policy Implications

In this section we follow Cruz and Marques (2014), one of the first papers to apply Simar and Wilson's double-bootstrap technique (2007) to test how exogenous variables affect the relative efficiency found in section VI. This procedure relies on a coherent data generating process to produce a pseudo-frontier which takes into account the sampling distribution of the bias term. In this study we compute "Algorithm #2" where 100 replications were used to generate bias-corrected estimates of a previous truncated (rather than censored) regression. Afterwards, 2000 replications were employed to calculate confidence intervals at 95%. At this phase, one should bear in mind that since the dependent variable in the previous method is an inefficiency estimate, a positive (negative) value for a given coefficient corresponds to a negative (positive) relationship between the respective environmental variable and municipal performance. At the 0,05

Table 3. Summary statistics and theoretical hypothesis for 2006 and 2010 (Source: own construction)

Variables	Mean	Std. dev.	Min	Max	Obs	Hypothesis
Population Density						**?**
2006	0,3125	0,8538	0,0057	7,3381	278	
2010	0,3104	0,8334	0,0052	7,1254	278	
Age Dependency ratio						–
2006	0,5892	0,1231	0,4002	1,0874	278	
2010	0,5941	0,1195	0,3861	1,0845		
Same Political Party dummy						**?**
2006	0,3633	0,4818	0	1	278	
2010	0,4317	0,4962	0	1	278	
Leftist Mandates (%)						–
2006	54,5699	0,2501	0	100	278	
2010	57,1115	0,2585	0	100	278	
Majority dummy						**?**
2006	0,9029	0,2967	0	1	278	
2010	0,9065	0,2917	0	1	278	
Abstention in local election years						–
2006	34,0968	7,5218	17,700	53,7	278	
2010	36,3806	7,5816	18,9	55,9	278	
Graduates (%)						+
2006	6,0618	0,0293	1,4870	26,5621	278	
2010	7,5204	0,0324	2,5641	28,7062	278	
Mean value of real estate						**?**
2006	65,1189	59,6469	5,9500	637,412	278	
2010	58,9760	53,3142	3,5440	516,311	278	
Number of first instance courts						+
2006	1,1007	1,3235	0	14	278	
2010	1,0576	1,4258	0	14	278	
Highway dummy						**?**
2006	0,5396	0,4993	0	1	278	
2010	0,5540	0,4980	0	1	278	
Unemployment rate (%)						**?**
2006	6,1996	2,0757	1,7396	14,3627	278	
2010	7,5043	2,3091	2,5828	15,7055	278	

level, β is only statistically significantly different from zero when both the lower and the upper bounds of the confidence interval have the same signal.[21]

A preliminary calculation is run using all aforementioned variables.[22] Then, we decided to remove, for each specification, variables that displayed broadly symmetric bounds. Several robustness checks were performed to assess the trustworthiness of our options.[23] Tables 4 and 5 report the results for 2006 and 2010, respectively.

[21] For more details on Simar and Wilson's double-bootstrap (2007) see the Technical Appendix.

[22] Results are offered in Table A.7 and Table A.8. In 2006, the *Age dependency ratio* and *Leftist mandates* are found to be negatively associated with performance. For 2010, however, we are not able to find any statistically significant result, a clear sign of the magnitude of the financial crisis on efficiency.

[23] In this exercise, we used two other variables computed with micro data from *Quadros de Pessoal*. In the wealth component, we substituted the *Mean value of real estate* for the average total wage per capita in the municipality. We did not include both due to collinearity reasons. The same aspect can be referred for the next two variables. In the part related to human capital, *Graduates* (%) was also replaced for the percentage of workers with knowledge intensive occupations (i.e., engineers, natural or social scientists, business or legal professionals and technicians operating in the fields of mathematics and health). Both cases yielded broadly similar results to those presented in Tables 4 and 5.

Table 4. Simar and Wilson (2007) double-bootstrap results in the baseline specification for 2006 (Source: own construction)

		Confidence Interval (95%)		Effect on
	β	Upper Bound	Lower Bound	Efficiency
Demography				
Age Dependency ratio	1,0484	0,3046	1,7922	–
Political Preferences				
Same Political Party dummy	-0,1956	-0,3842	-0,007	+
Leftist Mandates (%)	0,0054	0,0028	0,008	–
Majority dummy	0,1680	-0,2044	0,5404	
Human Capital				
Graduates (%)	0,0261	-0,2358	0,288	
Justice				
Number of first instance courts	-0,0541	-0,1932	0,085	
Labor Market				
Unemployment rate (%)	0,0363	-0,0191	0,0917	
Econometric Control				
δ	0,7013	0,5861	0,8165	

Table 5. Simar and Wilson (2007) double bootstrap results in the baseline specification for 2010 (Source: own construction)

		Confidence Interval (95%)		Effect on
	β	Upper Bound	Lower Bound	Efficiency
Demography				
Population Density	-0,0086	-2,0631	2,0459	
Age Dependency ratio	0,3030	0,0552	0,5508	–
Political Preferences				
Same Political Party dummy	-0,0469	-2,2244	2,1306	
Majority dummy	0,1509	-3,1277	3,4295	
Abstention rate (%)	0,0682	-0,0196	0,1560	
Human Capital				
Graduates (%)	-0,0004	-0,3215	0,3207	
Justice				
Number of first instance courts	-0,0514	-1,2041	1,1013	
Accessibility				
Highway dummy	0,3822	-0,6353	1,3997	
Econometric Control				
δ	2,3327	1,4761	3,1894	

In 2006, three items were found statistically significant in our analysis.[24] First, the *age dependency ratio* seems to be the main driver of inefficiency in the period, which may be explained by the ageing problem. Concerning the political determinants, right-wing local governments appear to outperform *leftist* ones. One should, however, take cautiously into account what is being evaluated. It could perfectly be the case that if some other "social" or "environmental" outputs were included, these results would be somehow different. More importantly, citizens who vote for left-wing parties may prefer to have more public goods provided by public firms or a less unequal environment. Conversely, the dummy that reflects the fact that the prime minister and

[24] In general, statistically significant empirical findings side with those of Cruz and Marques (2014).

mayor belong to the *same political party* seems to exert a positive effect over efficiency. This result is nonetheless richer if one takes into account the conclusions put forward by Veiga (2011, p. 232): "…the distribution of grant funding is skewed towards municipalities with more competitive races and where parties in central government have stronger political support." Therefore, aligned local authorities may easily find other financial sources *vis-à-vis* mayors with weaker political ties with the central authorities. In this regard, one should not be confused with the interpretations that followed Figure 6. If we pointed out that more financially dependent municipalities are, *on average,* less efficient, we are now going one step further by saying that, *controlling for comparable* municipalities, some may be able to achieve higher performance levels due to positive externalities emanating from a closer relationship with the government.

In contrast, we were only able to identify one driver of local performance for 2010. This outcome gives *per se* a clear idea of the strong impact of the Global Financial crisis on Portuguese municipalities. A high *age dependency ratio* seems to be accountable, once again, for decreasing regional efficiency in fostering the conditions for firm location and growth. This structural issue, thus, must be met with properly designed policy recommendations. For example, specific policies aimed at attracting young entrepreneurs to inland regions, by facilitating their access to finance, may constitute a step in the right direction. In addition, the importance of technological upgrade programs to promote incumbents exporting capacities should also be underlined.

IX. Final Remarks

The current thesis aims to examine the institutional role of municipalities in creating the conditions to encourage private initiative, opportunity recognition and willingness to take risks. We contribute to the literature in three major issues. To begin with, we study, for the first time, the previous research question using Data Envelopment Analysis

(DEA) to assess efficiency and a demanding double-bootstrap to evaluate its determinants. Second, we compare the effects after and during the Global Financial Crisis by selecting two post local (and national) election years (2006 and 2010). Moreover, we depart from the related literature where the most widely used input variables are measures of spending size rather than fiscal responsibility. Last but not least, we use both desirable and undesirable outputs in the first and an extensive range of environmental traits in the second stage.

This study has also its limitations. Besides the classical problem of choosing all the relevant variables to assess efficiency, exacerbated by a strong opposition against implementing performance evaluation models in Portuguese municipalities, one should bear in mind that some of them may be strongly constrained in their movements towards the production function. These usual claims are hereby dealt, to the extent that is possible, by performing several (preliminary) regression-based robustness checks.

Our study presents additional evidence that the effects of an ageing population are particularly important for regional development. We find that during both normal times and in times of crisis, more dependent municipalities (not only in demographic terms but also in financial resources) are, *on average*, less efficient.

In the future, with increasingly detailed available data, it may be possible to extend our investigation with new institutional variables (e.g., average days until payment, transparency and fiscal stability indices) or across economic sectors. For instance, the differences between the consequences of entrepreneurship due to pecuniary or knowledge externalities should be explored.[25] To conclude, new avenues of research may unlock efficiency as well as effectiveness from the point of view of three distinct concerns: sustainability, accountability and quality of life.

[25] Whereas resource endowments and low labor costs may be relatively more important to common firms and respective suppliers, the capacity of attracting innovative people is a key input to technological ventures (Audretsch et al., 2010).

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Appendix

Table A.1 International comparisons on local governments (Source: own construction with data from *EU Subnational Governments: 2010 Key Figures.* 2011/2012 Edition)

Country	No. of municipalities (2010)	Average number of inhabitants	Total public expenditure (% GDP)	No. of municipalities (1950)
Austria	2357	3.560	8,2%	3999
Belgium	589	18.480	7,1%	2669
Denmark	98	5.590	37,6%	1387
Finland	336	15.960	22,5%	547
France	36697	1.770	11,8%	38814
Germany	11533	7.080	8,0%	24772
Greece	325	34.780	2,8%	5959
Italy	8094	7.470	15,7%	7781
Netherlands	418	39.740	17,2%	1015
PORTUGAL	308	34.380	7,2%	303
Spain	8116	5.680	24,3%	9214
Sweden	290	32.340	25,5%	2281
United Kingdom	406	152.680	14,0%	2028

Table A.2. Definition of Inputs (I) and Outputs (O) in the baseline specification for 2006 and 2010 (Source: own construction, adapted from Arouca, 2013)

Variable	Operational Description	Data source
(I) *Industrial area*	Percentage of municipal area allocated for industrial usage according to the official *PMOT:* Municipal Spatial and Land use Plan	*DGOTDU*
(I) *Tourism area*	Percentage of municipal area allocated for industrial usage according to the official *PMOT:* Municipal Spatial and Land use Plan	*DGOTDU*
(I) *Primary expenditures/ Total Expenditures*	Total annual expenditure of municipalities minus annual interest payments divided by total annual expenditures	*INE a)*
(I) *Construction ratio*	Ratio between predicted duration of construction works and effective duration of construction works (in months)	*INE b)*
(O) *Entry_inc*	Number of firms attracted to each municipality divided by the number of firms functioning in the same area	*Quadros de Pessoal*
(O) *Exit_inc_inv*	Inverse of the number of firms leaving the municipality divided by the number of firms still functioning in the same area	*Quadros de Pessoal*

Notes:
Acronyms for sources of annual raw data correspondence: *DGOTDU* (Office for Spatial Planning and Urbanism), *INE a)* (Statistics Portugal- Regional Statistical Yearbooks), *INE b)* (Statistics Portugal- *Inquérito aos Projectos de Obras de Edificação e de Demolição de Edifícios* and *Estatísticas das Obras concluídas*).
Remaining doubts are answered by the author upon request.

Table A.3. Previous robustness checks (Source: own construction)

	I		II	
	Entry_inc		***NetEntry_inc***	
Infrastructural Geographic Area				
Industrial Area	0,0794***	(0,0287)	0,1009*	(0,0539)
Tourism Area	0,0202***	(0,0588)	0,0222*	(0,0112)
Governance Responsibility				
Primary Exp/ Total Expenditures	0,1091***	(0,0375)	0,5809***	(0,0801)
Licensing outline				
Construction Ratio	0,0117*	(0,0069)	0,0203*	(0,0114)
Political Preferences				
Same Political Party dummy	0.0031**	(0,0016)	0,0026*	(0,0026)
Leftist Mandates	0,0032	(0,0038)	-0,0055	(0,0063)
Majority Dummy	0,0002	(0,0002)	-0,0016	(0,0044)
NUTS 2 Dummies	*Yes*		*Yes*	
Year Dummies	*Yes*		*Yes*	
Econometric Control				
Constant	-0,0136	(0,0375)	-0,6263***	(0,0789)
Summary Statistics				
Number of observations	1946		1946	
R^2	0,2688		0,2748	

Notes:
All explanatory variables were lagged one period to account for potential endogeneity.
A broader sample from 2003 to 2010 is studied to assure results are stable in the long-run.
Roughly similar results were found for the 2006 and 2010 period. Three controls are added to examine Political Preferences.
Significance at 10% denoted by *; 5% by **; 1% by ***. Robust standard errors are given in parenthesis.

Figure A.1. Average efficiency scores in the baseline specification per year using a quadratic fitting (Source: own construction)

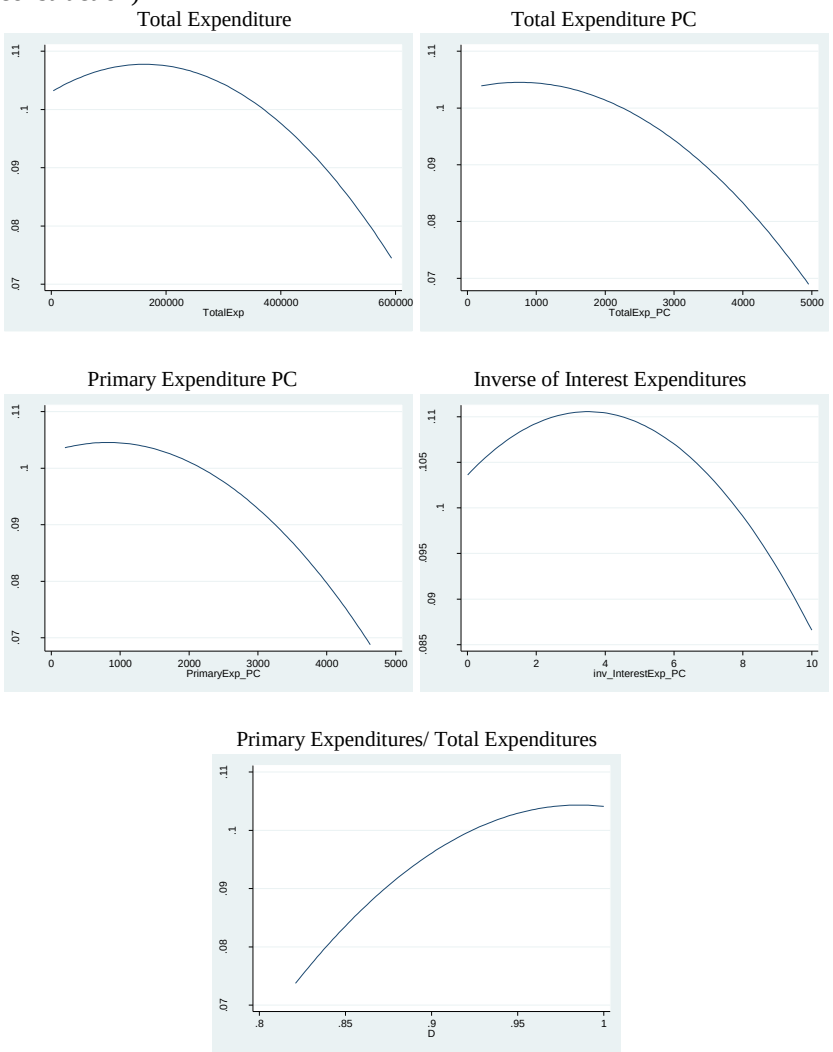

Table A.4. Definition of environmental variables in the baseline specification for 2006 and 2010 (Source: own construction, adapted from Arouca, 2013)

Variable	Operational Description	Data source
Population Density	Ratio of resident population per squared kilometre of municipal territory (k inhabitants per km^2)	*INE a)*
Age Dependency ratio	Ratio of individuals typically not in the labor force (aged 0-14 and 65+) and active population (aged 15-64)	*INE a)*
Same Political Party dummy	Coincidence between the prime minister and mayor's political party (in those cases, the dummy variable is equal to one)	*DGAI*
Leftist Mandates (%)	Percentage of mandates in the municipal local authority assigned to parties or coalitions ideologically leftist (PS, CDU and BE)	*DGAI*
Majority dummy	Existence of a majority governing the Municipal Assembly (in those cases, the dummy variable is equal to one)	*DGAI*
Abstention in local election years	Percentage of voters in the municipality who refrained or abstained from voting in local elections years (2005 and 2009)	*DGAI; INE a)*
Graduates (%)	Percentage of employees working in the municipality who hold a university degree (tertiary level of education)	*Quadros de Pessoal*
Mean value of real estate	Average value of real estates traded throughout the year in the municipality (k € per estate)	*INE a)*
Number of first instance courts	Number of General and Specialized and Specific jurisdiction courts of first instance in the municipality	*INE a)*
Highway dummy	Existence of at least one highway passing through the municipality (in those cases, the dummy variable is equal to one)	*INE a)*
Unemployment rate (%)	Percentage of registered unemployed per 100 active aged individuals in the municipality	*IEFP*

Notes:
Acronyms for sources of annual raw data correspondence: *DGAI* (Office for Internal Affairs), *INE a)* (Statistics Portugal- Regional Statistical Yearbooks), IEFP (Institute for Employment and Vocational Training)
Remaining doubts are answered by the author upon request.

Table A.5. Correlation Table for the 2006 specification (Source: own construction)

	1	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***	***11***
1	1										
2	-0.3190	1									
3	-0.0121	0.0439	1								
4	0.0047	-0.0001	0.4843	1							
5	-0.1979	0.1062	0.0457	-0.0894	1						
6	0.3657	-0.4158	-0.0428	0.1393	-0.1742	1					
7	0.5741	-0.3146	-0.0926	0.0018	-0.1813	0.4514	1				
8	0.3467	-0.4160	-0.0441	0.1622	-0.1094	0.4681	0.4328	1			
9	0.5205	-0.2676	-0.0349	-0.0686	-0.1865	0.3261	0.4949	0.3211	1		
10	0.1833	-0.4421	-0.0074	-0.0453	-0.0836	0.3183	0.2765	0.3014	0.2944	1	
11	0.0918	-0.2246	0.0950	0.1289	0.0470	-0.1502	-0.0175	0.0535	0.0795	0.0048	1

Notes: *1. Population Density; 2. Age Dependency ratio; 3. Same Political Party dummy; 4. Leftist Mandates (%);5. Majority dummy; 6. Abstention in local election years; 7. Graduates (%);8. Mean value of real estate; 9. Number of first instance courts; 10. Highway dummy; 11. Unemployment rate (%)*

Table A.6. Correlation Table for the 2010 specification (Source: own construction)

	1	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***	***11***
1	1										
2	-0.2826	1									
3	-0.0070	0.0063	1								
4	-0.0056	0.0452	0.5046	1							
5	-0.1669	0.0379	-0.0194	-0.0740	1						
6	0.3193	-0.3175	-0.0928	0.0039	-0.0924	1					
7	0.5234	-0.2656	-0.0460	-0.0151	-0.1451	0.4208	1				
8	0.3793	-0.3774	-0.0032	0.1632	-0.1223	0.3417	0.4260	1			
9	0.4846	-0.2007	0.0209	-0.0417	-0.0738	0.2345	0.4525	0.2964	1		
10	0.1896	-0.4020	-0.0362	-0.1069	-0.0645	0.3144	0.3167	0.3295	0.2600	1	
11	0.0673	-0.2510	0.1213	0.0227	0.0101	-0.0823	-0.1000	0.0007	0.1156	0.0278	1

Notes: *1. Population Density; 2. Age Dependency ratio; 3. Same Political Party dummy; 4. Leftist Mandates (%);5. Majority dummy; 6. Abstention in local election years; 7. Graduates (%);8. Mean value of real estate; 9. Number of first instance courts; 10. Highway dummy; 11. Unemployment rate (%)*

Table A.7. Preliminary Simar and Wilson (2007) double bootstrap results in the baseline specification for 2006 (Source: own construction)

		Confidence Interval (95%)		
	β	Upper Bound	Lower Bound	Included?
Demography				
Population Density	0,0047	-0,2295	0,2389	No
Age Dependency ratio	1,8550	1,0797	2,6302	Yes
Political Preferences				
Same Political Party dummy	-0,1709	-0,4727	0,1310	Yes
Leftist Mandates (%)	0,0078	0,0015	0,0140	Yes
Majority dummy	0,1420	-0,3156	0,5995	Yes
Abstention in local election years	0,0047	-0,0128	0,0222	No
Human Capital				
Graduates (%)	-0,0258	-0,0904	0,0389	Yes
Wealth				
Mean value of real estate	-0,0007	-0,0037	0,0024	No
Justice				
Number of first instance courts	-0,0732	-0,2284	0,0821	Yes
Accessibility				
Highway dummy	-0,0144	-0,2991	0,2704	No
Labor Market				
Unemployment rate (%)	-0,0666	-0,1490	0,0158	Yes
Econometric Control				
δ	0,6726	0,5428	0,8024	Yes

Table A.8. Preliminary Simar and Wilson (2007) double bootstrap results in the baseline specification for 2010 (Source: own construction)

		Confidence Interval (95%)		
	β	Upper Bound	Lower Bound	Included?
Demography				
Population Density	-0,7579	-1,7305	0,2147	Yes
Age Dependency ratio	0,06205	-0,5102	0,6343	Yes
Political Preferences				
Same Political Party dummy	-0,2156	-1,3997	0,9685	Yes
Leftist Mandates (%)	-0,00545	-0,0273	0,0164	No
Majority dummy	-0,3791	-2,0425	1,2843	Yes
Abstention in local election years	0,0359	-0,0298	0,1016	Yes
Human Capital				
Graduates (%)	-0,0477	-0,2637	0,1683	Yes
Wealth				
Mean value of real estate	0,0095	-0,0024	0,0214	No
Justice				
Number of first instance courts	-0,4439	-0,9725	0,0847	Yes
Accessibility				
Highway dummy	0,2649	-0,9161	1,4459	Yes
Labor Market				
Unemployment rate (%)	0,0406	-0,1597	0,2409	No
Econometric Control				
δ	1,9731	1,3614	2,5848	Yes

Technical Appendix

Let θ_{0A} denote VRS estimates of an output oriented DEA computation of relative performance scores (as we did in section VI). As previously explained, a second stage is then performed in order to assess how environmental factors Z_i (described in section VII) impacted on θ_0. However, problems arise from the fact that:

a) θ_{0A} is a biased estimator of θ_0;
b) θ_0 is serially correlated Z_i;
c) the error term $\boldsymbol{\varepsilon}_i$ is correlated with Z_i given that x_i and y_i are both correlated with Z_i.

To solve the abovementioned issues, Simar and Wilson (2007) developed methodology using a double-bootstrap procedure. The overall idea is to obtain bias corrected estimates of θ_0:

$$\theta_{0B} = \theta_{0A} - \hat{\text{bias}}\,(\theta_{0A})$$

and use them to compute

$$\theta_{0B} = f\,(Z_i\,;\,\boldsymbol{\varepsilon}_i)$$

where B denotes bias corrected estimates of a previous approximation A.

The procedure consists of the following steps:

1) Considering the original data, construct estimates of $\theta_0\,(x_i,y_i)$ for all DMUs by DEA;
2) By maximum likelihood (ML), calculate θ_0 and $\delta_{\boldsymbol{\varepsilon}}$ from the normal truncated regression $\theta_{0A} \approx Z_i\beta + \boldsymbol{\varepsilon}_{ij}$ (only estimates of $\theta_0 > 1$ will be used in this step);
3) Loop over the next three steps for L bootstraps estimates (in our case, 100 and 2000, respectively) for β_A and δ_A:
   For each j = 1, …, 278 draw $\boldsymbol{\varepsilon}_{ij}$ from $N\,[0, \delta_{\boldsymbol{\varepsilon}}^2\,]$ distributed with left truncation at $(1 - Z_i\,\beta_A)$;
   Compute $\theta_0 = Z_i\,\beta_A + \boldsymbol{\varepsilon}_i$;
   Coming back to the ML truncated regression to estimate $\varphi^* = Z_i\,\beta + \boldsymbol{\varepsilon}_{ij}$.
4) Use the bootstrap values estimated in 3) and the original β_A and $\delta_{\boldsymbol{\varepsilon}\mathbf{A}}$ to create confidence intervals (in our case, at 95% level) for β and δ.

Table 1. Variables and Findings of the related literature (Source: own construction, adapted from Cruz and Marques (2014))

First Stage Inputs (I) and Outputs (O)	Second Stage Non-discretionary Factors	Innovations and Results
1) De Borger et al. (1994) using 589 Belgian municipalities (I) *No. of white collar workers; No. of blue collar workers; surface of buildings owned by the municipalities*. (O) *Surface of municipal roads; No. minimal subsistence grants; No. of students in local primary schools; Surface of public recreational facilities; Ratio of nonresidents to residents.*	*Population; No. of coalition parties; Dummies for the liberal and socialist parties; Per capita Income; Size of the block grants; Share of the adult population holding a degree of higher education.*	Population and higher education rates have a positive efficiency effect. Block grants yield a negative influence; the presence of liberals and the average personal income also seem to affect performance.
2) De Borger and Kerstens (1996) using 589 Belgian municipalities (I) ***Municipal expenditures.*** (O) *No. of beneficiaries of minimal subsistence grants; No. of students enrolled in local primary schools; Surface of public recreational facilities; Population; Fraction of the population older than 65.*	*No. of coalition parties; Dummies for the liberal and socialist parties; Income per capita; Property tax rate; Size of the per capita block grants; Share of the adult population with just a primary education degree; Population density.*	Property rate tax and population density seem to exhort a positive influence. Personal income, the size of the per capita block grants and the percentage of population with only primary education have a negative influence on efficiency.
3) Prieto and Zofio (2001) using 209 Spanish municipalities (I) ***Personnel expenditure; Other operational expenditure; Current transfers; Capital transfers; Capital expenditure.*** (O) *Population; Number of lighting points; Urban waste collected; Street infrastructure area; Area of public parks; Quality.*	*Tax revenue; Size of block grants; Self-generated revenue; Financial liabilities; Financial deficit; Percentage of votes attained by the ruling party.*	Block grants and high percentage of votes for the governing party have a negative influence; the remainder variables may also have a negative impact.
4) Balaguer-Coll et al. (2007) using 414 Spanish municipalities (I) ***Expenditures on goods and services; Current transfers; Capital expenditure; wages and salaries.*** (O) Population; Tons of waste; Street infrastructure; Public parks; Quality	*Taxes; Grants; Self-generated revenues; Financial liabilities; Deficit; Votes received by ruling party candidates*	Empirical evidence towards the idea that resources may be better allocated by large municipalities.
5) Loikkanen and Susiluoto (2005) using 353 Finish municipalities (I) ***Total expenditures.*** (O) *No. of children daycare centres; No. of visits to basic health and dental care; Institutional care of the elderly and handicapped; Hours of teaching; Total loans in municipal libraries*	*Population; Earned income; Education level; Location and physical structure distance; Age of employees; Producer of services (% of all service) bought from other municipalities*	The most efficient municipalities were rather small. Political variables and turnover in local elections did not explain efficiency while Peripheral location, high income, and high unemployment tend to reduce it.
6) Sousa and Stósic (2005) using 4796 Brazilian municipalities (I) ***Total current expenditures;*** *No. of teachers; No. of hospital and health centers; Rate of infant mortality.* (O) *Population; Literate population; School enrollment; School attendance; Promotions to the next grade; Students in the proper grade; Water coverage; Wastewater coverage; Waste coverage*	*Tourism; Scale*	Touristic and very small municipalities tend to have lower efficiency scores.
7) Bönisch et al., (2011) using 203 German municipalities (I) *Labor;* ***Capital;*** *Resources and intermediate inputs.* (O) *Population; child care places; children in elementary school; traffic and recreational area; employees*	*Population density; Share of senior citizens; Relative population change; Type of municipality; Debt per capita; Relative equalization Transfers; Unemployment rate*	Centralized organizational forms displayed no efficiency advantage over local associations/municipalities.
8) Afonso and Fernandes (2008) using 278 mainland municipalities (I) ***Total expenditures*** (O) *Local Government Output Indicator*	*Distance to the district capital; Population with secondary education; Population with tertiary education; Per capita purchasing power; Population density; Annual population growth.*	Purchasing power and education have a positive influence. Distance to the capital of district may have a negative influence.
9) Cruz and Marques (2014) using 308 Portuguese municipalities (I) *No. Of staff;* ***Capital expenditures; Other operational expenditures***. (O) *Population, Extension of municipal roads, urban waste collected; driking water supplied; wastewater treated; No. of infrastructures*	*Tourism, Island, Topography, Illeteracy, Concentration, Purchasing power, Financial independence, Area, No. of parishes, Public housing, Net debt*	One of the first papers to apply Simar and Wilson (2007) procedure. Empirical evidence suggesting a clear difference between mainland and overseas municipalities.

Notes: Free Disposable Hull (FDH) technique, another non-parametric method which relaxes the convexity assumption required on DEA, is also used by papers 1), 2) and 4).
Some Portuguese variables were not used in this paper due to consistency reasons or lack of data availability (for example, the *number of infrastructures* or the *purchasing power* for 2006 and 2010).